BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

TECHNICAL SPECIFICATION FOR 1.1 KV CROSS-LINKED POLYETHYLENE INSULATED (HEAVY DUTY) ARMOURED PVC SHEATHED UG CABLE.

1.00 **SCOPE:**

The scope of this specification covers the design, manufacture, stage inspection at work, inspection and testing of finish cables at manufacturers works, testing at independent test house, packing, transport and delivery to consignee address of 1.1 KV stranded aluminum, XLPE insulated heavy duty armoured and sheathed power cable for working voltages up to and including 1100 volts underground cables as per specified construction.

2.00 **TECHNICAL REQUIREMENT:**

1.1 KV grade, 90º C rating heavy duty power cable with stranded circular shaped aluminum conductor cross linked polyethylene insulated inner sheathed of extruded PVC, galvanized steel strip armoured and PVC ST-2 overall sheathed.

The cable should be suitable for use in solidly earthed system.

3.00 **STANDARDS:**

3.1 The 1.1 KV UG cable shall, in general meet the requirements of the latest edition of the Bureau of Indian Standards (Generally refereed as IS), IS: 7098 (Part-I) 1988.

3.2 The cables and components in general shall meet the requirements of the following standards with latest amendments or equivalent international standards.

IS:7098 (Part-I)	1988	:	Specification for cross linked polyethylene insulated PVC sheathed cables.
IS:8130	1984	:	Specifications for conductors for insulated Electric Cables.
IS:3975	1988	:	Specification for mild steel wires, strips and tapes for armouring of cables.
IS:10810 (Part 1 to 55)	1984	:	Specification for test on cables.
IS:5831	1984	:	Specification for PVC insulation and sheath of electric cables.
IS:10418	1982	:	Specification for drums for electric cables.
IS:10462	1983	:	Fictitious calculation method for determination of dimensions of protective coverings of cables: part 1 elastomeric and thermoplastic insulated cable.

3.3 The 1.1 KV underground cables shall be manufactured to the highest standard quality, best workmanship with scientific material management and quality control. The bidder shall furnish the quality plan, giving in detail the quality control procedures/management system.

3.4 The successful bidder shall give sufficient advance notice to the purchaser of not less than fifteen days to arrange for stage inspection and inspection of quality assurance programme during manufacture, at the works.

3.5 Cable complying with other internationally accepted standards such as IEC, VDE, IPCEA etc., will also be considered in case they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard/standards adopted and furnish a copy of English version of the latest revision of standard(S) along with a tender and shall clearly bring the salient features for comparison.

3.6 In case of any conflict between the referred specification code or standards and this technical specification, the latter shall prevail to the extent of such difference.

3.7 1.1 KV Grade Power Cables to be supplied under this package shall be ISI approved and marked as such. Non compliance of above shall not be accepted.

3.8 However, if cable to be supplied under this specification are manufactured out side India and conform to other internationally accepted equivalent or superior standards the above clause shall not be applicable.

4.00 **DESIGN CRITERIA:**

4.1 The cables that are covered in these specifications are intended for use in the Karnataka Power distribution system, under the climatic conditions and installation conditions described in the technical specification.

4.2 Any technical feature, not specifically mentioned here, but is necessary for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under Technical deviations schedule only in the offer made by the bidder, giving technical reasons and justifying the need to incorporate these features.

4.3 For continuous operation of the cables, at specified rating the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 90º C under normal operation and 250º C under short-circuit conditions.

4.4 The cables in service will be subject to daily load cycles of two peaks during day, morning peak and evening peak, with reduced loading during the nights.

4.5 The materials used for sheaths shall be resistant to oils, acids, alkalies and chemicals.

4.6 The cables shall have the mechanical strength required during handling and laying.

4.7 The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.

4.8 The cables shall be designed to have a minimum useful life span of forty years.

4.9 Core identification: the core identification for cables shall be provided, by suitable means, like, by application of coloured stripes or any numerals or by printing on the cores as per Clause-10 of IS : 7098.

4.10 For identification coloured stripes, red, yellow & blue colours shall be used to identify the phase conductors & black to identify reduced neutral conductor.

5.00 **MANUFACTURE PROCESS, CROSS LINKING OF INSULATION:**

5.1 Cross linking of the insulation material (Pre compounded polyethylene) shall be conforming to IS:7098 (Part-I).

5.2 The conductor shall be of extruded semi conducting compound. The insulation screen shall consist of the non-magnetic metallic part. The XLPE insulation and the shields for conductor and insulation shall be extruded in one operation.

6.00 **MATERIALS:**

6.1 Conductor: the conductor shall be of stranded Construction. The material for conductor shall consist of plain aluminium of H2 or H4 grade as per Clause –3 of IS: 8130/1984.

The No. of wires in the conductor shall be not less than the appropriate minimum number given in Table-2 of IS: 8130/1984.

6.2 **INSULATION:** The insulation shall be cross linked polyethylene conforming to the requirements given in Table-1 of IS: 7098 Part-I.

6.03 For multicore cables, the interstices at the Centre shall be filled with a non-hygroscopic material. The interstices around the laid up cores shall be covered with PVC compound type S.T.2. This will form the inner sheath for multicores.

ARMOURING: The armour shall be galvanized steel strip, complying with the requirements of IS: 3975.

6.4 **OUTER SHEATH:**

The outer sheath shall consist of Poly Vinyl Chloride (PVC) compound, conforming to the requirements of Type ST-2 of IS:

5831 suitable additives shall be added to give anti termite protection.

7.00 **CONSTRUCTION:**

7.1 The general constructional features of the cables shall be as follows:

a) Stranded circular shaped Aluminium conductor. Cross linked polyethylene insulation, cross linked shall be conforming to IS: 7098 (Part-I) 1988 with its latest amendment. Extruded PVC inner sheath. Armour (Galvanized steel strip). Outer PVC sheath with anti-termite treatment.

b) Cables with reduced neutral conductor shall have sizes as given in table-2 of IS: 7098 Part-I.

8.00 **CONDUCTOR:**

8.1 The conductor shall be stranded circular shaped Aluminium wires of H2 or H4 grade plain aluminium wires.

8.2 The conductor shall be clean, uniform in size and shape smooth and free from harmful defects.

8.3 Not more than two joints shall be allowed in any one of the single

8.4 Forming every complete length of conductor and no joint shall be within 300mm of any other joint in the same layer. The joint shall be made by brazing silver soldering or electric or gas welding.

8.5 No joints shall be made in the conductor after it has been stranded.

8.6 **INSULATION:** The insulation shall be provided over the conductor with cross linked polyethylene, applied by extrusion and shall be of high quality, cross linked, shall be confirming of IS:7098 (Part-I).

8.7 **THICKNESS OF INSULATION:** The average thickness of XLPE insulation shall not be less than the nominal value subject to the applicable tolerance as specified in table 3 of IS: 7098.

8.8 The insulation shall be applied to closely fit on the conductor screen and it shall be possible to remove it without damaging the conductor.

9.00 **LAYING UP OF CORES:**

9.1 For multicore cables, the core shall be laid together with a suitable right hand lay, where necessary the interstices at the centre shall be filled with a non-hygroscopic material.

9.2 Inner sheath for Multi core cables:

9.3 The cores shall be laid up with a suitable right hand lay and the interstices should be filled with PVC compound type ST-2 conforming to IS: 5831 or equivalent standard.

9.4 The minimum thickness of the inner sheath shall conform to Table 5 of IS: 7098 (Part-I), 1988 or equivalent standard.

9.5 The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation.

10.00 **ARMOURING:**
Application

10.1 Armouring shall be applied over the insulation in case of single core cables and over the inner sheath in case of twin, three and multicore cables.

10.2 The armour stripes shall be applied as closely as practicable.

10.3 The direction of lay of the armour shall be left hand. For double strip armoured cables, this requirement shall apply to the inner layer of strips. The outer layer shall, except in special cases, be applied in the reverse direction to the inner layer and there shall be a separator of suitable non-hygroscopic material.

10.4 **DIMENTIONS:** The dimensions of galvanized steel stripes shall conform to table 6 of IS: 7098 (Part-I).

10.5 A binder tape may be applied on the armour.

10.6 **JOINTS:** The joints in armour strip shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any strip shall be at least 300 mm from the nearest joint in any other armour strip in the completed cable.

11.00 **OUTER SHEATH:**

11.1 The PVC outer sheath with anti termite treatment shall be extruded over the armouring for multi core cables and single core cables.

11.2 The colour of the outer sheath shall be black.

11.3 The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table 8 of IS: 7098 (Part-I) 1988.

12.00 **IDENTIFICATION:**

12.1 The outer sheath shall have the following information embossed or indented on it, the manufacturer’s name or trademark, the voltage grade, the year of manufacture and the letters “BESCOM”. The identification shall repeat every 300/350 mm along the length of the cable.

13.00 **CABLE DRUMS:**

13.1 Cables shall be supplied in Non returnable wooden or steel drums of heavy construction and drum shall be properly seasoned, sound

and free from defects, wood preservative shall be applied to the entire drum.

13.2 Standard length of each size of power cable to be supplied by the bidder shall be 500/1000 metres. The cable length per drum shall be 500/100 metres. The cable length power drum shall be subjected to a tolerance of ±5% of the standard drums lengths. Acceptance of smaller lengths of cables are subjected to approval of purchaser. Smaller lengths of less than 100 metres will not accepted.

13.3 A layer of waterproof paper shall be applied to the surface of the drums and over the outer most cable layer.

13.4 A clear space of atleast 40 mm shall be left between the cables and logging.

13.5 The cable drum shall carry KST marking with the following information stenciled on both sides of the drum. A tag containing the same information shall also be attached to the leading end of the cable.

a. Reference to the Indian Standards.
b. Manufacturer's Name, Brand Name or Trade Name.
c. Purchase's name, contract No. and date.
d. Type of cable and voltage grade.
e. Number of cores.
f. Nominal cross section area of the conductor.
g. Cable code.
h. Length of the cable on the drum.
i. Number of lengths on drum.
j. Direction of rotation of drum (by means of an arrow).
k. Net and gross weight.
l. Country of manufacture.
m. Year of manufacture.

13.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cables ends shall be scaled with good quality heat shrinkable caps so as to eliminate ingress of water during transportation and erection.

14.00 **QUALITY ASSURANCE PLAN:**

14.01 The successful bidder shall submit following information to the owner:

14.02 Test certificates of the raw materials and bought out accessories.

14.03 Statement giving list of important raw materials, their grades along with names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

14.04 List of manufacturing facilities available.

14.05 Level of automation achieved and lists of areas where manual processing exists.

14.06 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

14.07 List of testing equipments available with the bidder for final testing of equipment along with valid calibration reports.

14.08 The manufacture shall submit manufacturing quality plan (MPQ) for approval & the same shall be followed during manufacture and testing.

14.09 The successful bidder shall submit the routine test certificates of bought out raw material/accessories and central excise passes for raw material at the time of inspection.

15.00 **Guarantee**

15.1 The supplier of cables shall guarantee overall satisfactory performance of the cables.

15.2 At least three copies of type test reports shall be furnished. One Copy shall be returned duly certified by the owner, only after which the commercial production of the concerned material shall start.

15.3 Copies of acceptance test reports shall be furnished in at least Three (3) copies. One copy shall be returned duly certified by the Owner, only after which the materials shall be dispatched.

15.4 Record of routine test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

15.5 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

16.00 **Inspection**

16.01 The owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where cable, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub-supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

16.02 The material for final inspection shall be offered by the supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogenous and shall contain cables manufactured in 3-4 consecutive weeks.

16.03 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

16.04 No material shall be dispatched from its point of manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the later case also the material shall be dispatched only after satisfactory testing specified here in has been completed.

16.05 The acceptance of any quantity of material shall in no way relieve the supplier of his responsibility for meeting all the requirements of the specifications and shall not prevent subsequent rejection, if such materials are later found to be defective.

17.00 **QUALITY CONTROL:** The Bidder shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement.

During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards.

The Bidder shall arrange for inspection by the purchaser, during manufacture, if so desired by the purchaser to verify the quality control process of the Bidder.

18.00 **TYPE TESTS:**

18.1 Not withstanding that type test have been conducted earlier, the successful bidder the each member of consortium shall conduct all type tests as per IS: 7098 (Part-I) 1988, with upto date amendments or equivalent international standard and supplies made only after approval of test reports from the purchaser.

18.2 All type tests, routine, acceptance test shall be conducted in the presence of the purchaser, representative.

18.3 The successful bidder shall give FIFTEEN days advance notice for inspections and witnessing of tests by the purchaser or his representative.

18.4 The owner reserves the right to get the cable type tested at any of the BESCOM recognized testing house/laboratory at his own expense for any further tests to verify the compliance with the specifications and to reject the cables in case they are found not satisfying the qualifying requirements as per relevant standards.

18.5 The following type tests will be conducted on the cable as per IS: 7098 (Part-I) .

a Test on conductor.
b Test on armour strip.

c Test for thickness of XLPE insulation and inner & outer sheaths.
d Physical test on XLPE insulation.
e Physical test on out sheath.
f Insulation resistance (volume resistivity) test.
g High voltage test.
h Flammability test.

18.6 ACCEPTANCE TEST:
The sampling plan for acceptance test shall be as per IS: 7098 (Part-I) 1988.

18.7 The following shall constitute the acceptance test.
a) Tensile test for aluminium.
b) Wrapping test for aluminium.
c) Conductor resistance test.
d) Test for thickness of insulation.
e) Test for thickness of inner and outer sheath.
f) Hot-set test for insulation.
g) Tensile strength and elongation at break test for insulation and sheaths.
h) High voltage test.
i) Insulation resistance (Volume resistivity) test.

19.00 **ROUTINE TEST:**

The following shall constitute routine tests:
a) Conductor resistance test.
b) High voltage test.

20.00 **SEALING OF CABLE ENDS ON DRUMS:**

20.1 The cable ends shall be sealed properly so that ingress of moisture is completely prevented.

20.2 The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi-conducting layer on the cores may be removed for about 2mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

20.3 The multi cores should have an overall heat shrinkable cap with adequate end clearance and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable.

The ends of single core cables shall also be sealed on the same lines to prevent entry of moisture.

20.4 **CABLE LENGTHS:**

The cables shall be supplied in continuous lengths of 250-500 Mtrs in case of multi core cables with a tolerance of ±5% of drum length.

21.00 **GUARANTEED TECHNICAL PARTICULARS:** Guaranteed technical particulars of the cables to be supplied is enclosed.

22.00 **SCHEDULE OF DELIVERY:** The details regarding the delivery schedule are given in the Purchase Order/Dispatch instructions.

23.00 **DRAWING & LITERATURE:** The following shall be furnished along with the tender.

a) Cross sectional drawings of the cables, giving dimensional details for each size of cable.

b) An illustrated literature on the cable, giving technical information on current ratings, cable constants, short circuit ratings, derating factors for different types of installation, packing date, weights and other relevant information.

General Manager El,
Procurement,

BESCOM